Patent Application of

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for an Invention Titled:

REMOVABLE MAINTENANCE PORT AND METHOD FOR REHABILITATING MANHOLE

FEDERALLY SPONSORED RESEARCH:

Not Applicable.

SEQUENCE LISTING OR PROGRAM:

Not Applicable.

BACKGROUND - FIELD OF INVENTION:

This invention relates to the field of apparatus and methods for access to, and repair of, underground sewer, water, and other underground pipes; and is more specifically directed to an improved mechanism to provide access to, and to rehabilitate pre-existing access to, such underground pipes, such as an existing manhole.

BACKGROUND - DISCUSSION OF PRIOR ART:

Sanitary sewer systems generally include a series of

manholes that are connected by sewer pipes to move waste water from sources to a sanitary treatment site. These manholes are most often constructed of concrete or block material and are conventionally shaped of cone, corbel, and bench sections. Typically, the manholes are placed more than a thousand feet apart and are connected by sewer pipes. Conventional manholes are four to five feet in diameter, and each is large enough to admit a maintenance worker into its interior, by design.

The problem with conventional manholes is that they catch water that flows into the manhole from ground level. The water can also flow in from many places, including cracks in the cone and corbel. The cracks are caused by shifts in the surrounding ground, temperature changes that affect the cement, wear from vehicle traffic, and so forth. The blocks or cement of the manholes is also susceptible to disintegration from acids created in sewer systems. Repair is required on a regular basis, and is generally an expensive proposition.

There have been attempts to replace conventional manholes. Reinforced, preformed, plastic casings have been used to replace

the concrete manholes. The plastic casings purportedly cost less and eliminate some of the problems found in the concrete manholes. For example, they are less affected by temperature changes, they generally do not crack, and they are impervious to acids in the sewer system. However, current systems have their own problems. For example, the size of some casings makes them expensive to ship, and each casing may not match the requirements of the site terrain where it is to be installed. Additionally, the casings have to be sealed at the bottom to prevent leaks. Moreover, the access can be inconvenient. Maintenance is generally destructive, or at least as expensive as in conventional manholes.

Other attempted replacements have been suggested to overcome problems associated with installing a one-piece, plastic manhole casing. The other suggested casings are segmented in various ways to be assembled and installed at the site. While these casings are less expensive to ship, they are labor intensive at the installation site. They have a single input and output that are of standard size for sewer pipe in line at the sites.

The segmented and slotted casings are prone to leak and may float if installed in an area with a high water table. Most of these preformed casings are constructed of a cone, corbel, and bench in the manner of a concrete manhole. If the casing leaks, water may destroy the complete installation. Unless the casing is securely placed on a concrete foundation and surrounded by a fill material, a high water table can cause it to float and break the connections to input and output sewer pipes.

Consequently, it is not always economical to install a manhole of concrete or preformed plastic into which a maintenance worker can enter. Rather, a less expensive, more easily maintained underground pipe access can be installed to access the underground pipes, which does not necessarily accommodate a human being, but which can accommodate certain maintenance equipment.

Moreover, this apparatus can be removed, so that the conventional manhole remains, thereby permitting access to human maintenance workers. Unlike previous attempts, the removal is non-destructive.

The Port can be made of preformed plastic, polyethylene,

fiberglass reinforced resin, or a similar material. It is formed in a shape to be placed below ground inside of a manhole or similar access to underground pipes. It is impervious to acids in the sewer system, and it need not be large enough for a person to enter into its body cavity for maintenance. However, it is large enough to admit equipment into its inner body for maintaining the connecting pipes, that is, equipment to clean out the pipes or admit remote video cameras to inspect the pipes. It is watertight and may have waste water connections that receive water into its inner body from several sources and access the waste water to the sanitary sewer system through an output pipe, just as conventional manholes do. The port is placed below ground and held in position by its own base, which is fixed in the ground. It is not a manhole per se. Rather, it replaces and rehabilitates a manhole by providing an impermeable chamber that is smaller than a conventional manhole, yet the top of which can be removed to access the manhole by maintenance workers in the conventional fashion.

Previous inventions have tried to provide underground pipe

access of pre-formed bodies that are smaller than a conventional manhole used in sewer systems, but that can only be removed by destroying them. These purported to be water tight, and available for placement below ground with access to an inner body at ground level. These previous inventions provided only limited non-destructive entry to the inner chamber of the manhole from ground level for maintenance.

The invention resolves a number of problems that previous inventions have not yet addressed.

OBJECTS AND ADVANTAGES:

The object of the invention is to provide access to existing manhole structures and the like, for creating and accessing manhole structures and the like, and providing a method for rehabilitating existing manhole structures and the like, using the apparatus described. The invention is suited for accessing vertical, generally tubular structures which can benefit from insertion of a liquid and gas impermeable chamber which prevents leakage of liquid or gas through the manhole structure into the

environment, and which further benefit from more convenient access and non-destructive maintenance and repairs. The invention also eliminates gluing, bonding, or coating of manhole structures, their constituents, and the like. The invention may be used in areas of heavy traffic, as are conventional manholes, in places like city streets and thoroughfares.

The composite material used minimizes the weight of the unit, allowing installation with a minimum of manpower and machine power. The composite material can be cut in the field easily, and so can accommodate pipes of varying diameters, heights, and relative angles.

The variations of the apparatus permit prefabrication with stubout holes, or, alternatively, with pre-installed, commercially available T-type inserts, and with commercially available boot-type means for sealing. These variations will substantially minimize the construction and labor costs involved.

The Removable Maintenance Port also provides easy access to the interior of a manhole like system. The apparatus makes it easier to insert maintenance equipment, and to perform tying,

hydro cleaning, and hand-rodding, all of which can be done without removing the top unit.

The top unit of the apparatus is also removable, which dramatically improves access to the manhole type systems to allow for line rehabilitation, i.e., in the manner of a conventional manhole. After rehabilitation, the top unit may be returned to its position and re-sealed with a standard cover. This aspect is not provided by any of the prior art, and permits human inspection and maintenance in a manner that neither destroys the existing manhole, nor destroys the apparatus.

The base unit is fixed in the ground, usually by cementing it in place. Because the base unit is predominantly below the underground pipes, and the underground piping flows through the base unit, the base unit remains in place during all maintenance and inspection. The base unit is an improvement over the prior art because it is a fixed base which supports the removable top unit, permitting non-destructive maintenance and inspection.

The apparatus can be used to access any underground facility, utility access, vault, cave, mine, tunnel, compartment,

or similar structure.

The apparatus may also be installed as a new "manhole" or underground utility access device itself.

The apparatus and the method of using it preserves existing manhole structures for future use, even when the manhole structure develops leaking pipes, is no longer water-tight, or develops other similar problems.

Further objects and advantages of this invention will become apparent from a consideration of the drawings and ensuing description.

REMOVABLE MAINTENANCE PORT AND METHOD FOR REHABILITATING MANHOLE

DESCRIPTION OF INVENTION

DESCRIPTION AND ADVANTAGES:

The invention comprises an apparatus for accessing existing manholes structures and the like; and for creating and accessing new manhole structures and the like; and a method for rehabilitating manhole structures and the like, using the apparatus. The invention is suited for accessing vertical, generally tubular structures which can benefit from insertion of a liquid and gas impermeable chamber which prevents leakage of liquid or gas through the manhole structure into the environment, and which further benefit from more convenient access and non-destructive maintenance and repairs. The invention also eliminates gluing, bonding, or coating of manhole structures, their constituents, and the like. The invention may be used in areas of heavy traffic, as are conventional manholes, in places like city streets and thoroughfares.

The Removable Maintenance Port (Port) takes advantage of the corrosion resistance of fiberglass, or other composite material, and the structural support recently made available by commercial advances in the strength of composite materials, without concrete or metal supports. The invention is better than any of the prior art devices because the composite material minimizes the weight

of the unit, allowing installation with a minimum of manpower and machine power. The invention also allows the composite material to be cut in the field easily, to accommodate pipes of varying diameters, heights, and relative angles. The system can also be prefabricated in final form, i.e., with stubout holes, or, alternatively, with pre-installed, commercially available, T-type inserts, and with commercially available boot-type sealing means, so that construction and labor costs are minimized.

PREFERRED EMBODIMENT - Figs. 13, 1, and 2:

The Port comprises two sections: a top unit, which is load-bearing; and a base unit, which is load bearing. In the preferred embodiment, the invention comprises a minimum dynamic-load rating of 16,000 lbf. These two units may be installed and connected, top unit over base unit, on site. As shown in the embodiments, Fig. 13, Fig. 1, and Fig. 2, the Port may be combined with manhole devices of the prior art.

A typical embodiment of the Port is illustrated in Fig. 13, according to the present invention. The Port of Fig. 13 comprises an upper cylindrical portion, or upwardly extending riser portion, or hollow cylindrical tube, known throughout this description as a top unit. The top unit comprises any corrosion resistant load-bearing composite material. In its best mode, the Removable Maintenance Port is a fiberglass reinforced polyester,

manufactured from commercial grade polyester resin, with fiberglass reinforcements.

DETAIL OF TOP UNIT:

The top unit of Fig. 5, and also in Fig. 13, is open, with a top external flange. In the preferred embodiment, the top unit has an inner diameter of 25 in. This, for example, permits insertion into a standard manhole of 48 in., without destroying or altering a prior-art manhole already in place.

The top unit, as in Fig. 5, may be sealed with a standard manhole cover, as in Fig. 1, which is removable as shown in Fig. 9, by unbolting the manhole cover. This provides easy access to the interior of the system. The interior of the top unit is readily accessible from the ground for inserting maintenance equipment, and for performing tying, hydro cleaning, and hand-rodding, without removing the top unit. The top unit is also removable, to allow all types of line rehabilitation; after rehabilitation, the top unit may be placed over the top of the bottom unit and re-sealed with a standard cover.

In the preferred embodiment of the invention, the top unit's upper external flange supports a standard manhole ring and cover, as in Fig. 1, Fig. 2, and Fig. 6. In the preferred embodiment, the top unit's upper external flange also has pre-cut eyeholes that may be used to move the top unit on installation and

removal, and which may also be used for bolting in place a standard removable manhole ring and lid, as in Fig. 9.

The top unit has a variable depth, and, while not drawn to scale, is shown in the best mode in Fig. 13 extending downward from below the surface of the roadway to a depth above the highest opening for a pipe or outlet on a base unit.

The inner diameter of the top unit is larger than the outer diameter of the base unit, as seen in Fig. 1, Fig. 2, Fig. 3, Fig. 4, Fig. 6, and Fig. 8. This is clearly shown in Fig. 2, the cross-sectional environmental view of the entire system, and more specifically in Fig. 4, the enlarged partial cross-section view of the interface between the top unit and the base unit at circle 4-4 on Fig. 2.

The top unit may have an internal lower flange which rests on top of the base unit, as shown specifically in Fig. 4, and as shown generally in Fig. 2 and Fig. 3. In the preferred embodiment, the top unit does have an internal lower flange. The top unit is load bearing. The base unit is load bearing.

Fig. 4 shows the preferred embodiment for sealing the interior. In Fig. 4, a partial cross-section taken from Fig. 2, the drawing shows an o-ring gasket surrounding the base unit, below the top of the base unit, sealing the gap between the outer

diameter of the base unit and the inner diameter of the top unit.

DETAIL OF BASE UNIT:

The base unit, in its preferred embodiment, shown in Fig. 2 and Fig. 6, has a closed bottom 1 in. thick, with a bottom external flange of 3 in. The closed base unit is inserted into wet concrete, with the bottom of the base unit inserted into the concrete below the lowest line for any fluid flow, such as incoming or out-going pipes, in the preferred embodiment.

In the preferred embodiment, the base unit has stubout holes, permitting the insertion of composite sewer pipe, as shown in Fig. 14, a partial cross-sectional view of the base unit. Alternatively, the base unit stubout holes also permit insertion of commercially available T-type fittings, with commercially available sealing boots.

As shown in Fig. 14, the base unit, in its preferred embodiment, has a fiberglass enclosed invert and bench area, 4 in. above the incoming pipelines. The invert and bench are formed using a non-corrosive composite material which is completely enclosed in a fiberglass chop.

As shown in Fig. 2 and Fig. 4, the preferred embodiment for the base unit has a beveled top, with an outer diameter that fits

inside the inner diameter of the top unit.

In the preferred embodiment, after installation, inert crushed stone backfill surrounds the base unit, as seen in Fig. 1 and Fig. 6, to a distance of at least one foot from the outside surface of the base unit, and to a height of at least 6 in. on the base unit from the bottom of the excavation. The backfill is placed in layers.

DETAIL OF COMPOSITE MATERIALS:

In the preferred embodiment, the inner-most surface of the Removable Maintenance Port, both top unit and base unit, is a resin-rich layer. The resin, in the preferred embodiment, is a commercial grade unsaturated polyester resin. The interior surface has no exposed fibers and is free of crazing, and free of visible defects.

Moving outward from this resin-rich inner-most layer, as diameter increases, the next layers are a minimum of two passes of chopped roving, applied uniformly. Each pass of chopped roving is well-rolled prior to the application of additional reinforcement.

In the preferred embodiment, as diameter increases, additional reinforcing material is applied moving outward,

commercial Grade "E" type glass, in the form of continuous roving, and chop roving, with a coupling agent that bonds between the glass reinforcement and the inner resin and inner surface.

In the preferred embodiment, after the inner layer has been applied, the walls of the Removable Maintenance Port are constructed with chop and continuous strand filament wound manufacturing processes.

In its preferred embodiment, the resin on the exterior surface of the entire Removable Maintenance Port has a gray pigment added. The exterior surface is hand-worked smooth with no sharp projections, with no delamination, and with no fiber showing.

The Port may be comprised of any composite material such as fibreglass, polyethylene, or preformed plastic; all of which must be sufficient to withstand the imposition of a load. The preferred embodiment of the port comprises a top unit and a base unit made of the same composite material, although the different units need not be made of the same composite material.

The thickness of the base unit is a variable dependent upon the material that it is made from. In the preferred embodiment, the device depends upon the base to support the entire load. Even in the alternate modes, the Port depends at least in part

upon the base to support the load. The thickness must be sufficient for the composite material, so that the base will withstand imposition of a load.

DETAIL OF ALTERNATIVE EMBODIMENTS:

In Fig. 2 and Fig. 3, alternative embodiments of the invention comprise a top unit with an external upper flange, and a separate internal lower flange, where the bottom of the top unit extends to and is flush with the top of the pad upon which the base unit is embedded. Fig. 5 illustrates the difference between the preferred embodiment and one of the alternative embodiments of the top unit, with the alternative top unit shown at the bottom of Fig. 5 in dashed lines.

In Fig. 2, the invention comprises an alternative form of the base unit that has an external flange with an open bottom, where the base unit is exposed to the bottom of the manhole, concrete pad, or earth, or other fill material.

In Fig. 6, at circle 7-7, and in Fig. 7, the Port comprises an alternate embodiment where the top of the base unit is a flat surface, and the means of sealing the gap between the outer diameter of the base unit and the inner diameter of the top unit is closer to the top of the base unit.

In Fig. 8, an exploded view, the Port comprises a base unit

where the entry and exit pipes are not necessarily perpendicular, are not necessarily the same diameter, and are not necessarily at the same elevations.

In Fig. 10, an alternative to Fig. 9, taken from circle 9-9 at Fig. 6, the upper flange of the top unit is an interior flange with an optional support. This embodiment supports non-standard manhole covers, custom covers, and other covers for the top of the unit.

In Fig. 11, an alternative to Fig. 9, taken from circle 9-9 at Fig. 6, the upper flange of the top unit is an external flange, formed so as to protect the means used to affix the manhole. Fig. 11 and Fig. 12 comprise an upper flange of the top unit without an external support.

In Fig. 12, an alternative to Fig. 9, taken from circle 9-9 at Fig. 6, the upper flange of the top unit is an external flange without an physical means of affixing the cover, permitting an adhesive means, and further permitting the on-site formation of other appropriate means of attaching the cover, such as by forming a hole for a nut and bolt.

In Fig. 15 and Fig. 16, the Port alternatively comprises two alternative spacing units. Fig. 15 shows the invention comprises a spacing unit with a flat bottom and a beveled top. Fig. 16

shows the invention comprises a spacing unit with a flat bottom and a flat top. Fig. 17, a cross-sectional view, alternatively shows the invention comprises the spacing unit of Fig. 15 in place, extending the height of the base unit, and raising the top of the top unit, so that the top of the unit cover may correspond to newly laid asphalt, or some other change in the distance to the surface. The preferred embodiment of the Port does not comprise any spacing units.

Fig. 18 shows a number of alternative embodiments of the Port, comprising any of the following top units, all with variable heights: (a) as shown with an upper exterior flange, and a lower internal flange, and a bottom flange, with housing that extends over the pipes protruding from the base unit; (b) as shown with an upper exterior flange, with a lower internal flange, and with housing that extends over the pipes protruding from the base unit; (c) as shown with no upper flange, or with an interior upper flange, with a lower internal flange, and with a housing that may or may not extend over the entire housing of the base unit; (d) as shown with an upper exterior flange, with no internal flange, with housing that extends over the pipes protruding from the base unit; and (e) as shown with no upper flange, or with an interior upper flange, with no internal lower flange, and with housing that may or may not extend over the entire housing of the base unit.

Fig. 18 further shows the invention comprises an o-ring gasket or other seal for the gap between the inner diameter of a top unit and the outer diameter of a base unit. The seal may be placed on the base unit at or below the top of the unit.

Fig. 18 further shows a number of alternative embodiments of the Port, comprising any of the following base units: (a) a base unit with pipes at different angles; (b) a base unit with pipes of different diameters; (c) a base unit with pipes at different elevations; (d) a base unit with no external pipes, or with no external flange, or both; and (e) a base unit with a variable height.

DETAILED MEASUREMENTS FOR BOTH UNITS:

The depth of the top unit may vary at least from 6 in. to 40 ft., or more. The inner diameter of the top unit is variable, at least from 25 in., up to 72 in., or more.

The depth of the base unit may vary at least from 8 in. to 6 ft., or more. The base unit may also be field cut to lower the height of the base unit, correspondingly lowering the height of the entire Port. The outer diameter of the base unit is normally smaller than the inner diameter of the top unit, and may vary accordingly from 24 in. up to 71.5 in., or more.

The bottom flange of the base unit varies at least from 2

in. to 12 in., or more, measured from the base unit outward. The bottom flange of the base unit is optional, although it is the preferred embodiment.

The top flange of the top unit varies from at least 3 in., measured from the exterior wall of the top unit, and may be made at least large enough to accommodate any standard size manhole ring and cover, known to those skilled in the art.

The diameter of optional stubout holes for pipes in the base vary at least from 4 in. to 12 in., or more.

ADDITIONAL ADVANTAGES:

The system can be used to access any underground facility, utility access, vault, cave, mine, tunnel, compartment, or similar structure.

In alternative embodiments, the top unit may be polygonal, oval, or other geometric shape, in order to conform to an access chamber already in place. In these alternative embodiments, the base unit would accordingly change its shape so that it fit within the top unit, and could be sealed tight with an external o-ring gasket or other sealer, so as to be impermeable to water, gas, and air.

This Port may also be installed as a new manhole, or underground utility access device. When assembled below ground level, it accepts pipes with input and output. The incoming and outgoing pipes may be of various sizes, angles, and heights, and can be quickly connected.

DETAIL OF METHOD:

When a manhole structure or the like develops a leaking pipe, or leaks, or is no longer water-tight, the method of the invention preserves the manhole structure for future use. The invention comprises a method of rehabilitating manholes, such as standard sewer manholes, and like structures, using the apparatus.

The method of the invention comprises the steps of: removing the old pipes, connectors, and T-type inserts from the bottom of the manhole structure; leaving the manhole structure in place and otherwise intact; preparing the bottom of the manhole structure by clearing debris out of the manhole structure down to the concrete base, or down to the ground level, or both; inserting a base unit into the manhole structure; embedding a base unit into the ground or into a concrete pad; connecting the pipes to the base unit; sealing the connections between connecting pipes and base unit; backfilling around the base unit with inert material; mechanically tamping the inert material; adding additional fill as necessary to bring the top of the fill-line to a location above the lowest exposed part of the exterior

of the base unit; placing an o-ring sealing gasket below the top of the highest elevation of the base unit; placing a top unit with an inner diameter larger than the outer diameter of the base unit, over the top of the base unit; replacing the manhole ring or other device to secure the top of the top unit; re-surfacing the road or access facility in accordance with local standards, so that the highest elevation of the device securing the top unit is below the surface of the road or access facility; replacing the manhole cover, or other cover, over the manhole ring or other device securing the top of the top unit; and affixing the cover to the top of the top unit by bolting it or using an adhesive to affix it.

CONCLUSION, RAMIFICATIONS, AND SCOPE:

From the foregoing, it will be seen that this invention is one well adapted to obtain all the ends and objects herein set forth, together with other advantages that are inherent to the structures, method, and drawings.

It will be understood that certain features and sub-combinations are of utility and may be employed without reference to other features and sub-combinations. This is contemplated by and within the scope of the drawings, this description, and the claims that follow.

It is understood that obvious equivalents, modifications, and substitutions for elements of the above-described invention

may be apparent to those skilled in the art. The above examples are by way of illustration only; and the true scope and definition of the invention is to be set forth in the drawings and the claims that follow, which form an integral part of this description.